

DOSING MECHANISM

Background Information

5 The present invention is based on a dosing mechanism according to the species defined in the main claim.

In fuel cell-supported transportation systems, so-called chemical reformers are used for obtaining the required hydrogen from hydrocarbon-containing fuels.

10 All the substances needed by the reformer for the course of the reaction, such as air, water and fuel are ideally supplied to the reformer in the gaseous state. However, since the fuels, such as methanol or gasoline, are preferred to be present onboard the transportation system in liquid form, shortly before they are supplied to the reformer, they have to be heated first so as to vaporize them. This requires a pre-evaporator that is in a position to make available corresponding quantities of gaseous fuel and water vapor, the waste heat from the reformer mostly being used for the vaporization.

15 Since the hydrogen is mostly used immediately, chemical reformers have to be in a position to adjust the production of hydrogen to the demand, without delay, e.g. at load changes or launching phases. Especially in the cold-start phase, additional measures have to be taken, since the reformer does not make available any waste heat. Conventional evaporators are not in a position to generate the corresponding quantities of gaseous reactants without delay.

20 It is therefore useful to enter the fuel, by using an atomizing device, in finely divided form into the reformer, the vaporization process, at sufficient heat supply, being improved by the large surface area of the finely divided fuel.

25 Devices for reforming fuels are known, for example, from US 3,971,847. In this document, the fuel is metered, by metering devices that are relatively distant from the reformer, via long supply lines, into a material flow that has been brought to the right temperature, and are dispersed in the material flow, via a dosing aperture at the end of the supply line, and this flows to the location of the actual reforming process.

30 In the devices known from the above-named document it is particularly disadvantageous that the long supply lines lead to delays and inaccuracies in fuel metering, especially in the case of strong load changes or hot-start phases. If, after a stop phase, for example, while the fuel is evaporating under the temperature influence of the supply line, fuel metering is resumed, this may lead to delayed dosing of fuel into the tempered substance stream and to the reforming process because of the dead-space volume in the supply line that has first to be replenished. The same problem arises at particularly slight load. Furthermore, long supply lines act
35 counter to compact construction, increase error susceptibility and assembly expenditure.

Summary of the Invention

By contrast, the dosing mechanism according to the present invention, having the characterizing features of the main claim, has the advantage that, because of the thermal decoupling of the metering device from the transporting line that transports the tempered material flow, the length of the supply line between the metering device and the dosing aperture, and thus the dead-space volume present in it, is greatly reduced. Because of the clearly reduced dead-space volume, there is a clear improvement especially in the hot-start characteristics, the starting characteristics after a longer stillstand and the low-load characteristics of the dosing mechanism and the reformer.

Besides that, it is advantageous that the metering device may be mounted near the transporting line that transports the tempered substance stream, and thus a compact, reliable and cost-effective construction manner of the reformer is made possible. In addition, the metering devices do not have to be sufficient for increased requirements with regard to temperature loadability and temperature characteristics, and thus fuel injectors that are already known, have been proven many times, and are being used, can be installed.

Advantageous further developments of the dosing mechanism specified in the main claim are rendered possible by the measures given in the dependent claims.

Advantageously, as the metering device, a fuel injector is used, as is known, for example, from reciprocating engines using internal combustion. The use of such valves has several advantages. Thus, they permit a particularly accurate control and regulation of metering in fuel, the metering-in being able to be controlled via several parameters, such as the on-off ratio, the pulse frequency and possibly the stroke length. In this context, the dependence on pump pressure is considerably less marked than in metering devices which regulate the volume flow of the fuel via the line cross section, and the dosing range is clearly greater. In addition, the fuel injectors named are frequently proven components, whose characteristics are known, which are cost-effective, which are chemically stable to fuels and reliable components, this applying in particular to so-called low pressure fuel injectors, which may be used in this instance because of their thermal decoupling.

It is also of advantage that the insulating body is made of a ceramic material, since ceramic materials are particularly heat-resistant and conduct heat poorly. Besides that, if the insulating body is made up of several parts, that makes its assembly, and especially its disassembly substantially easier. If the insulating body encloses the transporting line in an annular fashion, a form-locking connection to the transporting line is established thereby.

The insulating body is advantageously grasped by a clamp, especially a ring-shaped clamp, and is fastened by fastening elements. Since ceramic materials, as a rule, are difficult to work

on and are brittle, the insulating body is advantageously at least partially surrounded by a non-ceramic, in particular a metallic jacket part in a form-locking manner, in order thus to be able to connect other components to the insulating body in a force-locking manner. By grasping the insulating body using a clamp, and the at least partial enclosing of the insulating body by the jacket part, it is possible to position the jacket part in a heat-insulating manner by using the clamp and the fastening element.

The dosing mechanism according to the present invention may also be advantageously developed further in that the holding crosspiece, having the accommodation which takes up the fuel injector, is connected via a detachable joint, such as a screw connection. This has a positive influence on the assembling characteristics, and easily permits, beyond that, to protect the accommodation additionally from heat from the holding crosspiece, for instance, by nonmetallic washers. By the flat design of the holding crosspieces, a reduced heat-conducting cross section is achieved, along with good mechanical stability.

If the dosing aperture is positioned approximately in the radial center of the transporting line, the input fuel is distributed particularly uniformly. A particularly good and fine distribution of the fuel may also be achieved by using several dosing apertures, in particular, several dosing apertures having different hole diameters, these also being able to be directed radially to the flow direction of the tempered substance stream. A particularly advantageous distribution of the fuel is also achieved by the input of fuel counter to the flow direction of the tempered substance stream.

Advantageously, the transporting line has a cross sectional constriction in its axial course. This enables the fuel clearly to mix better with the substance stream, and because of the thereby improved transition of heat to the fuel, it is clearly able to be evaporated faster.

For better heat uptake from the reformer, the supply line may be formed using means, such as heat vanes, for the improvement of heat absorption. These are advantageously mounted on the supply line by durable, stable, heat-resistant and well heat-conducting bonding methods, such as welding or soldering.

The dosing pipe advantageously has a number of locations at which the wall thickness is reduced, which lower the heat conductivity of the pipe and may also be used as cooling elements.

Brief Description of the Drawings

Exemplary embodiments of the invention are explained in greater detail in the following description and are shown simplified in the drawings. The figures show:

Figure 1 shows a schematic view of an exemplary embodiment of a dosing mechanism according to the present invention.

Description of the Exemplary Embodiment

An exemplary embodiment of the present invention is described below as an example.

5 An exemplary embodiment, shown in Figure 1 of a dosing mechanism 1 according to the present invention, is developed in the form of a dosing mechanism 1 for the use of low pressure fuel injectors. Dosing mechanism 1 is particularly suitable for the input and the atomization of fuel into a (not shown) chemical reformer so as to obtain hydrogen.

10 Dosing mechanism 1 is made up of a holding device 13, a metering-in device 2, which in this exemplary embodiment is designed in the form of a low-pressure fuel injector, a tube-shaped transporting line 10 that transports a tempered material flow, and a supply line 12 which opens out into a dosing opening 7 at one end lying in transporting line 10.

Holding device 13 is essentially made up of an accommodation 3 which is used to accommodate the part of metering-in device 2 at its outlet side and is fixed to it by a fixing
15 element 14 in the form of a simple clamp, and a holding crosspiece 4 for connecting and distancing accommodation 3 and metering-in device 2 to/from a jacket part 5, which annularly encloses an insulating body 6 that annularly surrounds transporting line 10. A clamp 8, that runs closely beside jacket part 5, likewise annularly around transporting line 10, fixes insulating body 6, or rather its individual parts (in the exemplary embodiment, two half
20 shells), around transporting line 10. In this context, clamp 8 is fastened with the aid of fastening elements 9, which in this exemplary embodiment are screws, and which press on lateral widenings of clamp 8, and thus clamp insulating body 6.

Accommodation 3, using its recess facing away from transporting line 10, takes up the outlet part of metering-in device 2 with an exact fit. Because of the fit, and the use of a (not shown)
25 seal in the (not shown) region of the (not shown) outlet opening of metering-in device 2, in this context, the outlet opening is connected hermetically sealed to supply line 12, which passes through the side of accommodation 3 facing transporting line 10. In this exemplary embodiment, one may do without stable joints between metering-in device 2 and accommodation 3, since a low-pressure fuel injector is used, which, as a rule, has fuel
30 pressures of only up to about 10 bar applied to it. Consequently, no great forces have to be transmitted during sealing, such as by massive screw connections. All components that have pressure applied to them may thus be dimensioned to be less strong, and may be manufactured more cost-effectively.

At opposite sides, at the lower region of accommodation 3 facing transporting line 10, two holding crosspieces are fastened laterally with the aid of screws 15 that pass through holding crosspieces 4 and gripping within the internal threads of accommodation 3. For thermal insulation, at this point nonmetallic washers, for example, may be used between holding crosspiece 4 and accommodation 3. Holding crosspieces 4 continue from there on to jacket part 5 and are there fixed to jacket part 5 by a welding connection, holding crosspieces 4 being formed in this region in such a way that they follow the shape of jacket part 5, and thus a greater connecting area is achieved between holding crosspieces 4 and jacket part 5.

Coming from accommodation 3, supply line 12 runs between the two holding crosspieces 4, at right angles to transporting line 10, through a lateral opening running elongated in the direction of transporting line 10, through insulating body 6 and through the wall of transporting line 10 right up to dosing aperture 7, which is directed, in this exemplary embodiment, towards an outlet opening 11 of transporting line 10, dosing aperture 7 being also able to be formed as a nozzle. Dosing aperture 7 introduces the fuel into a material flow that is tempered, for example, between 400⁰ C and 600⁰ C, and which is composed, for instance, of a mixture of air and water vapor.